The Second Science Team Meeting
of the
U. S. Department of Energy (DOE) and PRC Ministry of Sciences and Technology (MOST)
Joint Agreement on "Climate Science"
Ocotber 27-30, 2003

Beijing, China

Compiled by

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Executive summary

The Second Science Team gathering of the U. S. Department of Energy (DOE) and the People's Republic of China Ministry of Sciences and Technology (MOST) joint agreement on "Climate Sciences" was organized October 27-30, 2003 in Beijing, China. Two separate meetings were held, the first one on October 27-28 with the China Meteorological Administration (CMA) at the National meteorological Center/CMA, and the second on October 29-30 with the Chinese Academy of Sciences (CAS) at the Foreign Expert Building/Beijing. The U. S. delegation, including ten members, was led by Michael Riches of the DOE.

Both DOE/CMA and DOE/CAS meetings consist of: an opening session, the scientific presentations, a break-out session, and a summary session presenting the future collaborative research. This report summarizes, for each meeting: the future collaboration research, the agenda, the scientific presentations, and the list of participants.

I. DOE-CMA Meeting (October 27-28, 2003)

A. Future Collaborative Research

Task 1: Analysis of general circulation models

Global GCMs

AMIP
- Model results will be submitted to PCMDI for inclusion in AMIP; To better understand the model response to the IPCC scenarios; NCC will submit AMIP model results in several months for initial evaluation.

CMIP
- The NCC coupled model results will also be submitted to PCMDI for CMIP2.
- PCMDI will provide the model results from other AMIP and CMIP models to aid with NCC model development and diagnostics of the model performance in East Asia.

NWP
- Five day forecasts will be made by the NCC model starting at 0Z for each day during the period of June-July 1997 and March 2000.
- PCMDI will furnish detailed ARM observations and other in situ datasets to NCC from the IOP of June-July 1997 and March 2000 for comparison and evaluation.
- All variables available will be saved and compared with observations every 6 hours for the forecast period.
- One US scientist will visit NCC for a period of two weeks in 2004 to help interpreting model results.
- Model sensitivity to radiation and cloud parameterization (ISCCP) within the context of seasonal prediction

Regional GCMs

- Intercomparison experiments to investigate RCM sensitivity to domain size, boundary conditions, physics parameterizations, and model resolution for multiple years. These experiments will focus on seasonal simulations and interannual variability. Each participating modeling group will perform RCM simulations using different domain sizes, model resolutions, and boundary conditions (e.g., based on NCEP/NCAR and ECMWF reanalyses) for a full matrix of simulations that enable detailed analysis of the various factors and RCM sensitivity. Analysis will also investigate the effects of cloud-radiation interactions on model sensitivity.

- Investigate RCM downscaling ability to simulate interannual variability and applications to seasonal climate forecasts. Several tasks will be performed: (1) examine the skills of two or more GCM seasonal climate forecasts for East Asia; (2) intercompare RCM hindcast skill driven by one or more GCM seasonal climate forecasts. Our goal is to examine the factors that affect the RCM downscaling ability for seasonal climate forecasting and develop an optimal model configuration and model nesting procedure to improve seasonal climate forecasts for China. Analysis should also focus on air-sea interactions over the warm pool, which has been shown to be important for seasonal prediction of the summer monsoon. In addition, we will explore regional climate models that have coupled atmosphere-ocean components.

- Examine RCMs' ability in simulating historical climate conditions over East Asia. Three to four sets of 10-years RCM simulations will be performed for the present climate and historical climate corresponding to 1635-1644 (severe drought); 1680-1689 (minimum solar irradiance); and 1810-1819 (volcanic forcing). Large-scale circulation will be provided by the GISS and/or CAM simulations. Land use for each 10-year period will be prescribed based on a land use database for the past 300 years. Simulations will be evaluated using reconstructed historical climate data over China.

- Data Exchange: GISS/CAM historical simulation boundary conditions for 4 10-year periods and climate forcing NCEP/NASA and NCC global seasonal hind-cast boundary conditions Land use data for the past 300 years Reconstructed historical climate records 6-hourly precipitation station data?

- Scientist Exchange: One scientist from CMA to visit PNNL for 6-12 months. One scientist from PNNL to visit CMA for 1 week – 1 month

Task 2: Climate data preparation and analysis

- NCDC will provide CMA:
  - V. 2 of the Global Daily Climate Network. V. 1 provided at this meeting
  - V. 2 of the Global Historical Climatology Network include monthly avg. SLP, temperature and precipitation. Latest version of CARDS (January 2004)
- CMA will provide NCDC-CDIAC with updates to 200 station network for temperature and precipitation and other data types.

Task 3: Measurements of atmospheric trace constituents

- Carry out field measurements of methane and nitrous oxide fluxes from rice fields for both growing seasons using chamber methods at a frequency of 3-4 per week and replicates in 3 fields with up to 3 plots per field
- Weekly background sampling and measurements
- Soil production measurements of methane and nitrous oxide
- Collection of environmental data (water levels, soil and air temperature, plant heights, full agricultural practices data including amount and timing of fertilizer applications, planting and harvest dates, and other data as appropriate for the study.)
- Balloon based measurements for determining the large scale flux of methane (and nitrous oxide) from rice fields.

Personnel exchange: Principal investigators (Xu, Khalil and Rasmussen) will meet to agree on sites. US technical staff will work in the field to set up the experiments and work on the experiment. CMA staff will visit Portland State University of OGI for training or research as appropriate.

Task 4: Effect and impact of climate change on human and natural systems

- Objective: to develop the methods and tools to conduct climate change impacts studies at regional scale in China that include
  - Crop yields and productivity
  - Water resources
  - Soil carbon sequestration
  - Non-CO2 gases Plan
  - Test crop growth, water balance, and soil carbon modules in EPIC against experimental data in China
  - Conduct a comparative climate change impacts study on two regions in China and the U.S. Huang-Hai Plain of China, U.S. Great Plains
  - Scientist exchange: One young scientist from NCC-CMA to visit Joint Global Change Research Institute (JGCRI) to work on water resources modeling
  - JGCRI scientists to offer short course on modeling techniques of managed ecosystems and water resources
  - Funding: Develop proposals for MOST and NSF, DOE

B. Summary of Sessions

Opening Ceremony (*Chair: Ding Yihui*)

Zheng Guoguang, the Deputy Administrator, first welcome the participants to the Science Team meeting. Climate change is an important topic, in particular to China. He wish the meeting a success. Both Michael Riches and Zhou Shungguang, the U.S. and Chinese Coordinators respectively of the joint project, also expressed welcome and a productive

meeting. Introduction of the U. S. and Chinese participants are conducted for purpose of identifying the counterparts of each individual tasks. A photo session follows afterwards.

Session 1: The Observed Studies and Data analysis (*Chairs: David Easterling and Ren Guoyu*)

David Easterling started the session by presenting a talk that examined evidence for observed climate change. He focused on temperature and showed the global time series for temperature, then some other results that reinforce the conclusion of observed warming in high latitudes including satellite observations of sea-ice loss. Very recent results of a new analysis of maximum and minimum temperature trends for the 1950-2003 period show that the previously found trends continue with the minimum temperature warming faster than the maximum and a resulting decrease in the diurnal temperature range. He then presented results examining changes in different parts of the statistical distribution for daily max/min temperature showing that the warming in the higher latitudes of North America is occurring in the coldest days of each month with less warming in the warmest days.

Next Guoyu Ren described changes in the climate of China using instrumental data for temperature, precipitation and dust storms. He briefly described some of the quality control and homogeneity analysis of the data, then presented results showing an increase in maximum and minimum temperature since 1950. But for entire 20th century warm period in mid-20th century results in cooling until 1970s then strong warming. He also examined growing season changes showing a general increase in the season length. For all of China there is little precipitation increase but an obvious decrease in Yellow River basin is evident. For typhoon rainfall, there appears to be a decrease in both amount and the area impacted by typhoons.

Dale Kaiser presented results of an analysis of long-term snowfall changes in the United States using the Daily Historical Climatology Network data set. Data for all stations north of 35 deg N were examined for potential changes in snowfall over the 1948-2001 period. The largest changes appear to be significant decreases in snowfall in the Pacific Northwest and in the central U.S. The large PNW decreases appear to be consistent with temperature increases in the region suggesting that the snow line has increased in elevation.

Dataset development activities at the National Meteorological Center of China were described by Xiong Anyuan. Data sets included surface observational data sets of temperature, precipitation, and other variables (e.g. pressure) for 674 stations for the 1951-2001 period. Upper air data was also discussed and included both daily soundings and climate normal for 120 stations. Other data sets discussed included solar radiation data for 98 stations, agricultural data sets on crop growth, and global data received via the Global Telecommunications System. Metadata standards, quality control methods, inhomogeneity analysis of these data were also discussed.

Li Qingxiang then discussed in detail the work he is performing on the homogeneity of annual temperature data for the period 1951-2001. This work was designed to account for temporal inhomogeneities in the time series that occur due to instrument changes, changes in data processing methods, or station moves. He used the Easterling-Peterson method and tested its effectiveness and also a way to develop a reference series that accounts for a network wide change in 1960. Results show the E-P method works well and removed most of the significant discontinuities in the data resulting in temperature time series that are more representative of the temporal variability and change in temperature over China.

The final paper in the session was presented by Zhu Yanfeng and was a case study of the evolution of the 2003 summer precipitation regime for China. This included analysis of the movement of the monsoon as represented by precipitation centers. The monsoon was somewhat late in onset over the south China Sea as shown by analysis of outgoing longwave radiation measurements by satellite. Zonal and meridional wind anomalies for the 10-20 deg N, 110-120 deg E region also showed that the onset occurred in late May somewhat later than normal. The middle part of the season (late June-early July) also was drier than normal, and the withdrawal of the monsoon was in mid-late September which is earlier than normal. The late onset, dry middle, and early withdrawal resulted in drier than normal conditions in the region between the Yangtze and Yellow rivers, but severe flooding occurred in parts of the Huaihe River basin.

Session 2: Regional Impacts of climate change (*Chairs: Sun Leng*)

There were four presentations in this session, given by Ren Fumin on effect of typhoon on China's precipitation, Izaurralde on climate change and soil carbon sequestration potential in the North China Plain, Gao Ge and Gong Zhensong presting the anomalous precipitation event during the summer 2003.

The regional scale effects of extreme climate events and climate change on natural resources, agriculture, economy and so on had examined in this session. Major extreme climate events occurred in summer of 2003 in China such as the heavy rain over Huaihe River Basin, the hot waves and serious drought around South China as well as their severe impacts had been analyzed. Especially, the reason for precipitation anomalous in Huaihe River Basin had been given. The influence of South China Sea (SCS) summer monsoon, the subtropical high in west Pacific Ocean, the circulation and the blocking high in the middle-high latitudes were the major climatic causes. Tropical Cyclone (TC) activity was another cause of rainfall in China. The changing trend of TC and precipitation caused by TC had been shown for the period of 1957-1996. Finally, the potential of agricultural soil carbon sequestration of the Huang-Hai Plain in China had been assessed to act as sinks of atmospheric CO_2 under changing climate by combining climate change assessment techniques with soil carbon sequestration science and modeling. Under the HadCM3 A2 scenario with warming and wetting climate for the next 80-90 years, the response of soil organic C content in the top soil layer to changes in climate and management was highly dynamic.

Session 3 Modeling and Prediction (*Chairs: Luo Yong and Ruby Leung)*

Wei-Chyung Wang presented a plan to conduct regional climate simulations over East Asia during historical times. The goals of this study are to analyze the reconstructed monsoon variability over the past 500 years over East Asia and examine how well global and regional climate models can reproduce the main features of monsoon variability over three specific periods: 1635-1644 (severe drought); 1680-1689 (minimum solar irradiance); and 1810-1819 (volcanic forcing. Datasets of the various forcings including solar insolation, volcanic stratospheric aerosols, and greenhouse gas concentrations have been compiled for the period 1500-2000. Ensemble global simulations have been performed using the NOAA GISS and NCAR CSM models with the prescribed historical forcings for the 500 years period. Preliminary analyses show that the global simulations were able to reproduce a significant drop in surface temperature in response to the volcanic aerosol forcing for the 1810-1819 period. Regional climate simulations will be performed using the SUNYA ReCM for the three 10-years periods and results will be compared with the reconstructed climate for model validation.

Shi Xueli introduced the regional climate model, RegCM_NCC, developed at the National Climate Center based on the NCAR RegCM2 model. The model has been configured for operational seasonal climate forecasts using 79x151 grid cells at 60 km spatial resolution centered over China. The regional climate model has been driven by large-scale circulation from the NCEP/NCAR reanalyses (simulation mode) and GCM simulations (hind-cast mode) for 10 years from 1991-2000. The simulations have been evaluated based on observations. Generally, the model reproduced the regional climate over East Asia very well, with higher skill found in the simulation than hind-cast. Summer rainfall anomaly, however, was over-estimated in both the simulation and hind-cast. The model rainfall anomaly compared most favorably with observations over northeast China. In a recent study, the RegCM/NCC was used to produce seasonal climate forecast for the summer of 2003. The above normal rainfall in the Huaihe river basin and below normal rainfall in the Yangtze river basin were well predicted by the regional climate model. In contrast, the global climate model compared less favorably with the observed anomaly.

Gerald Potter introduced a US Department of Energy project that has been initiated recently on developing a parameterization testbed for global climate models. The CCPP-ARM Parameterization Testbed (CAPT) adopts a technique in which global climate models (GCMs) are initialized and used in a numerical weather prediction (NWP) mode to provide analyses of model errors. The rationale of this approach is that most GCM forecast errors can be attributed to parameterization deficiencies once the model's dynamical state is realistically initiated. In this project, GCMs are initialized using the ERA40 reanalyses every 5 days to produce 1-day to 5-day weather forecasts. By analyzing the model forecasts and compared to the ERA40 and observations, it was found that the forecasts using the NCAR CSM are too moist at the upper levels near 300mb. The model has a tendency to trigger deep convection very often and transport moisture too far up in the atmosphere. By implementing a new parameterization for triggering cumulus convection (Xie and Zhang 2000), the CSM was able to more realistically

simulate rainfall over the tropical Pacific Ocean, which removed a major bias associated with the double ITCZ found in most GCMs.

Ruby Leung described a recent study that examines the effects of aerosols on the regional climate and hydrological cycles in South Asia. The study makes use of the aerosol radiative forcing estimated based on ground-based, aircraft, and satellite measurements obtained during the Indian Ocean Experiment (INDOEX). Two 10-years simulations were performed using an MM5-based regional climate model for 1991-2000, with large-scale circulation provided by the ECMWF analysis. The difference between the two simulations, with and without the prescribed aerosol radiative forcing, provides an estimate of the effects of aerosols on the regional climate in Asia. Results show that with the presence of aerosols, the net solar radiation at the surface is reduced by up to $40W/m^2$, which causes a cooling of up to 1^oC during the winter monsoon season over India. In addition, there is a warming of near 1^oC over the Tibetan Plateau, which seems to be associated with reduced cloud cover that may result from changes in regional/large scale circulation in the presence of aerosol. These simulations will be further analyzed to understand how aerosols affect regional climate and hydrological cycle and the feedback mechanisms that might play an important role in the response.

Xu Ying described the NCC and IAP joint development of a high-resolution coupled atmosphere-ocean global climate model to produce climate change scenarios under different emission scenarios. The NCC/IAP has been applied to project the future climate under the IPCC A2 and B2 emission scenarios. The model simulated a near linear trend in the warming over China and East Asia that is comparable to observations. Analyses have been performed to examine the changes in the summer monsoon index in the next 50 years. In general, mean temperature in East Asia and China will increase by 1-2^oC and ~1.4^oC respectively and precipitation will decrease over most regions in East Asia. Results showed more intense summer monsoon over South Asia and South China Sea. Winter monsoon will be weaker in North China. In addition both the intensity and frequency of cold waves will be reduced in the future under both emission scenarios.

Li Qiaoping described a 5-year simulation (1998-2002) produced by the RegCM_NCC model at 60 km spatial resolution over East Asia. The simulation was driven by large-scale conditions from the NCEP/NCAR reanalysis over a domain with 79x151 grid cells. The simulation has been compared extensively with the NCEP/NCAR reanalysis and observations to examine the model's ability to reproduce the East Asian monsoon climate. Results showed that the simulation generally captured the large-scale circulation including features of the subtropical high, upper-air winds, temperature, and humidity quite well. The simulated subtropical high was, however, more intense and further north compared to the NCEP/NCAR reanalysis. In addition, there is a warm bias over land and cool bias over the ocean which results in larger land-sea contrast, stronger summer monsoon circulation, and more summer rainfall compared to observations. The

Session 4 Greenhouse Gases Measurements and Analysis (*Chair: M.A.K. Khalil and Wang Bangzhong)*

The first talk by Aslam Khalil dealt with methane and nitrous oxide emissions from rice fields. He pointed out that there has been much progress on understanding the processes and factors that affect methane emissions from rice fields, but this understanding is still insufficient for accurately calculating regional and world-wide emissions. He pointed to two major issues impeding such estimates, namely he difficulty of extrapolating measured fluxes to large scales and the rapidly changing emission rates due to changes in emission factors. He discussed two lines of research to address these issues. First are large scale direct measurements that use mass balance over regions of ~ 100 km^2 by using direct atmospheric measurements on tethered balloons. The other line of research was to aim at a process based phenomenological model to address the extrapolation to large scales. The work includes field studies of oxidation processes. Finally he pointed to the possible inverse relationship between methane and nitrous oxide emissions. He showed data from Qingyuan near Guangzhou in Guangdong Province. These data show progress in the current project with box method measurements of fluxes of methane and nitrous oxide, oxidation data and the inverse relationship between methane and nitrous oxide fluxes.

The second talk was given Xu Li of the CMA. She talked about a 2-d transport model applied to atmospheric carbon dioxide. The model was used to calculate the net emissions of carbon dioxide from which the fossil fuel emissions were subtracted. This showed a sink in the middle northern latitudes. The effects of ENSO on the atmospheric CO2 were also discussed.

The third talk was given by Rei Rasmussen. He reiterated the importance and the novelty of the large scale flux measurements using balloons. Further he discussed the development of new instrumentation to measure nitrous oxide in the field. This would be used in the program discussed earlier by Khalil. He showed preliminary data on the high precision measurements on soil samples.

The final talk was given by Ren Wanhui to present the data from the first crop at Qingyuan (this was from the same project discussed by Khalil in the first talk). He considered water levels and the timing of fertilizer applications to explain the changes of methane flux during the growing season. He applied the DNDC model from the University of New Hampshire. The model was able to explain roughly the occurrence of high flux rates but predicted several periods of no flux that was not supported by the observations. They are continuing the work to understand the discrepancy.

C. Agenda

October 28

9:00-9:20 **Opening Ceremony (*Chair: Ding Yihui*)**
Zheng Guoguang, Deputy Administrator
Michael R. Riches
Zhou Shuguang

9:20-9:40 **Photo-taking**

Session 1: The Observed Studies and Data analysis (*Chairs: David Easterling and Ren Guoyu*)

9:40-10:05 **David Easterling**: A review of research and data set development work at the National Climatic Data Center: 1985 – 2003

10:05-10:30 **Ren Guoyu:** Climate changes of the past 100 years in Mainland China

10:30-10:55 **Dale Kaiser:** Variability and trends in United States snowfall over the last half of the twentieth century

10:55-11:10 Tea Break

11:10-11:35 **Xiong Anyuan:** Construction of the meteorological dataset in China National Meteorological Center

11:35-12:00 **Li Qingxiang:** Detecting and adjusting on temporal inhomogeneity in Chinese mean surface air temperature dataset

12:00 **Lunch** (Guest house restaurant)

14:00-14:25 **Zhu Yanfeng:** Monsoon monitoring at NCC

Session 2: Regional Impacts of climate change (*Chairs: Sun Leng*)

14:25-14:50 **Ren Fumin**: Typhoon impacts on China's precipitation during 1957-1996

14:50-15:15 **RC Izaurralde:** Climate change and soil carbon sequestration potential in the North China Plain

15:15-15:40 **Gao Ge:** Main anormal (or extreme) climatic events in summer of 2003

15:40-16:05 **Gong Zhengsong:** The analysis of climatic causes of precipitation anomalous in Huaihe Basin during the summer of 2003

16:05-16:20 **Tea Break**

Session 3 Modeling and Prediction (*Chairs: Luo Yong and Ruby Leung)*

16:20-16:55 **Wei-chyung Wang:** Regional climate simulations during historical times

16:55-17:20 **Shi Xueli:** The use of RegCM NCC in seasonal prediction over China

17:20-17:45 **Gerald Potter:** The CCPP-ARM parameterization test bed (CAPT)

18:30-20:30 **Banquet**

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9:00-9:25 **L. Ruby Leung:** Simulating the regional climatic effects of the atmospheric brown cloud

9:25-9:50 **Ying Xu**: Climate scenarios in East Asia and China using the NCC/IAP T63 Coupled Model

9:50-10:15 **Li QiaoPing**: Multi-year Simulation over East Asia using a regional climate model

10:15-10:30 **Tea Break**

Session 4 Greenhouse Gases Measurements and Analysis (*Chair: M.A.K. Khalil and Wang Bangzhong)*

10:30-10:55 **M. A. K. Khalil**: Greenhouse gases from rice fields
10:55-11:20 **Xu Li**: Inverse model study of sources and sinks of atmospheric carbon dioxide: method development and preliminary results
11:20-11:45 **R. A. Rasmussen**: Greenhouse gases from rice fields
11:45-12:10 **Wanhui Ren**: Methane emissions from the early rice paddy fields of Qingyuan Region in China
12:10 **Lunch**

Break-Out Session ***(Chairs: Task Leaders)***

14:00-16:00 **Discussions**
16:00-16:30 **Tea Break**

Task Simmary ***(Chair: Wei-Chyung Wang and Ding Yihui)***

16;30-17:30 **Task leader presentations fo future joint studies**
18:00 **Dinner**

D. List of Participants

II. DOE-Chinese Academy of Sciences (CAS), October 29-30, 2003

A. Future Collaborative Research

Task 1 Analysis of general circulation models

Task 1a

- The 1997-98 El Nino caused large changes in cloud cover produced significant changes in the distribution of the planetary LW and SW cloud forcing. Zhang and Wang (Session 2 of this meeting) have shown the strong interannual variation of the cloud radiative forcing and the associated cloud characteristics and circulations.
- The IAP/UKMO will be expanded to look at the LW and SW cloud forcing terms and the associated variation in cloud height that was detected by various satellite systems.
- Simulations from the study by Lu and Dong will be made available to the US for analysis
- The SAGE II and CERES cloud height, SW and LW fluxes will be made available to the CAS/IAP and SUNYA.
- This exchange of data may result in a joint paper describing the model response to the major El Nino of 1997-1998.

Task 1b:

- A Scientist from CAS/IAP for a short visit to LLNL to aid in the diagnosis of the CAPT model output, AMIP data, and CMIP data.
- Benefit to the CAS/IAP will include training using the PCMDI climate model analysis toolkit, the diagnostic report generator and other diagnostic tools
- NCAR will collaborate with CAS/IAP to analyze future climate change simulations over East Asia. The effort will examine the changes important to society such as the discharge of the Yangtze River.

Task 1c: Historical Climate Simulations over East Asia:

Technical Tasks

- To examine RCMs' ability in simulating historical climate conditions over East Asia. Three to four sets of 10-years RCM simulations will be performed for the present climate and historical climates corresponding to 1635-1644 (severe drought); 1680-1689 (minimum solar irradiance); and 1810-1819 (volcanic forcing); or the 1990-2000. Large-scale circulation will be provided by the GISS and/or NCAR and/or IAP simulations while RCMs will be based on SUNYA and/or IAP models. Land use for each 10-year period will be prescribed based on a land-use database for the past 300-year, and longer if possible. Simulations will be evaluated using reconstructed historical climate data over China.

Data Exchange:

- 1. GISS/NCAR/IAP historical simulated lateral boundary conditions with and without climate forcing (volcanic, greenhouse gases, solar irradiance) for four, 10-year periods and climate forcing
- 2. Land use data for the past 300 years or to the extent possible
- 3. Reconstructed historical climate data

Participating Institutes:

- SUNYA; IAP; IGSNRR; Institute of Tibetan Plateau (ITP)

Scientist Exchange:

- 1.Ms. Hao Zhixin of IGSNRR/CAS to visit SUNYA for one year; One scientist from IAP to visit SUNYA for 3-6 months
- One scientist from SUNYA to visit IAP/IG/Institute of Tibetan Plateau for 1-2 weeks

Task 2: Climate data preparation and analysis

- NCDC will provide CAS
  - V. 2 of the Global Daily Climate Network, V. 1 provided at this meeting.
  - V. 2 of the Global Historical Climatology Network includes monthly avg. SLP, temperature and precipitation
  - Latest version of CARDS (January 2004)
- CAS will provide NCDC-CDIAC with 2000 winter-half year temperature and, when published will consider providing the 300 year precipitation reconstruction.

Task 3: Measurements of atmospheric trace constituents

There are four potential areas of collaboration dealing with methane and nitrous oxide emissions from rice agriculture.

- Trends of agricultural practices that affect China-wide methane emissions and may have led to decreases in the emissions over the last 2 or 3 decades. This area includes interviews with farmers and county agricultural agents to determine changes in agricultural practices
- Measurements of nitrous oxide from rice fields and other rotational crops on the same fields and determining the processes that affect these emissions. Long-term monitoring of nitrous oxide emissions from cropland and link the emissions with climate variation.
- Continue observations of trace gases in Minqin, Gansu Province. These measurements of greenhouse gases and ozone depleting compounds will complement our existing joint data set from 1985-1988 and 1996-1998. These data will be used for modeling global budgets.
- Measurements of trace gases in dust and non-dust periods along with aerosol measurements.
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Further details of possible collaboration will need to be worked out during the next month.

Task 4: Effect and impact of climate change on human and natural systems

- Documentation and analysis of phenology data from China during the last 40-year (SUNYA, IGSNRR)
- Comparison between the effects of climate change on phenology between China and USA (NCDC, IGSNRR)
- Effect of climate changes on crop rotations (SUNYA, IGSNRR)
- IGSNRR short term visitor to SUNYA & NCDC

B. Summary of Sessions

Opening Session

Panqin Chen opened the meeting and welcome the workshop participants. He provided a review of the evolution of the joint agreement, starting August 19, 1987, after a three years scientists-to-scientists exchanges. Chen then went on to outline the goals and the technical tasks and highlighted the significant achievements of the joint collaboration and looked forward to an even more productive joint research program into the future. He suggests that two aspects require particular attention in the future, the partnership among researchers and new direction such as the effect/impacts of climate changes. Chen concluded by indicating the change of management team, the new coordinator will be Feng Renguo and the Chief Scientist Wang Huijun. Afterwards, Michael Riches welcome the participants and wish a productive meeting.

Special Session

Michael Riches gave a review of the joint agreement, starting from a three-years scientists-to-scientists exchanges between 1984-1987, and then formally signed on August 17, 1987. He went on to highlight the accomplishments of the 20-years joint research, including the scientific

Session 1: Modeling and Climate Prediction (*Chairs: Gerald Potter and Lu, Riyu*)

Jerry Potter presented a summary of a new project to run climate models in an NWP mode in an attempt to isolate parameterization errors in models very early in a simulation. By applying NWP techniques of verifying predictions it was found that the NCAR CAM2 model produces a quite acceptable forecast of large scale atmospheric features but produces large errors in the representation of various physical processes. By modifying the way convection initiates, it was found that the model was improved dramatically. Although the modification was used to improve the model biases for summer near the ARM site in Oklahoma, it appears that another major model bias was also reduced in the Tropical Pacific. In the future, the test bed being developed will be exported to interested modeling centers.

Yu Yongqiang presented results from the LASG/IAP high resolution ocean modeling experiments. The LICOM model produces ENSO and the Indian Ocean Dipole. The

model also produces the Indonesia Through Flow (ITF). The CCSM2 has been modified to run with the LICOM model by using the NCAR flux coupler and run successfully and results are comparable to other coupled atmosphere/ocean models. The new coupled model (FGCM) produces ENSO-like variability.

Bob Cess presented a new analysis of cloud-radiative forcing (CRF) from a set of AMIP models. Many models exhibit a large bias in Net CRF that has all the same sign signifying too much short-wave cloud forcing. By isolating a few models over two select regions of the planet it was shown that even the best models (the lowest CRF bias) produce biases for the wrong reason in at least one of the regions. Errors in the model produced cloud height and optical properties continue to be the primary reasons the models still produce significant errors. Another disturbing issue is the wide range of LW and SW biases in the clear atmosphere.

Wei-Chyung Wang gave a brief historical perspective of the joint DOE-CAS study on Task 1: analysis of general circulation models. He went on to specifically present a summary of the proxy data obtained and documented during the past 20 years of the Joint Agreement. More recent data (the last century) agrees well with other dfata sets and shows the 1981-1999 dramatic increase over the 1951-1980 level. It was also interesting to note the rapid transitions between cold and warm periods over the past 2000 years. He also reported on joint regional GCM simulations over East Asia using a suite of models including SUNYA, CAS, U of Massachusetts, NASA-GISS, NCAR and Wood Hole. The results are still being studied but it is hoped that they will contribute to the factors affecting the climate of East Asia. He also presented results using a Regional Climate Model (RCM) to compare with proxy data and showed that Eastern China precipitation patterns favor certain modes of variability.

Aiguo Dai gave a summary of a large number of global change scenarios (and ensembles of scenarios) that have been performed using the NCAR Parallel Climate Model (a coupled atmosphere/ocean model customized to run efficiently on many parallel computers). He described a selection of the simulations that have been run for the historical (1870-1999) and future (21st and 22nd Centuries). The output data from these simulations have been made available to the public. Some of the global scale features include changes in the North Atlantic thermohaline circulation. Assuming a reduction in CO_2 emissions takes place in the future; the global temperatures exhibit a significant lag but begin to decline eventually.

Dabang Jiang used the IAP model with reconstructed prescribed sea surface temperatures to simulate the last glacial maximum (LGM). He used the model to explore the controversy of the existence of a continental ice sheet over the Tibetan Plateau during the LGM. In addition experiments, it was found that the Tibetan ice sheet had a profound effect on the climate of China. He also showed the influence of vegetation on the regional climate was an important factor in the LGM.

Lin Zhaohui discussed the IAP dynamical prediction system (DPS) and its application to the climate anomalies predictions over China. The IAP DPS produces a final prediction

product by correcting and averaging an ensemble of seasonal predictions. The system has considerable skill (correlations greater than 0.6 over many regions for temperature anomalies) and produces reasonable precipitation patterns in a hind-cast. Over Eastern China the predictive skill is lower for annual precipitation.

Riyu Lu reported on a collaborative study with Buwen Dong of the UK Met Office. They ran a version of the HadAM3 to study the 1997-1998 El Nino and its effect on East Asia. They also performed experiments to determine the effect of the Atlantic Ocean temperature anomalies on the circulation and the East Asian summer rainfall. They found the Atlantic Ocean temperature anomalies had a significant effect on the East Asian precipitation by triggering an equatorial Rossby and Kelvin wave and reducing the precipitation anomalies in the tropical Western Pacific.

The last paper in this session initiated a discussion about the use of the model to study other large scale features of the 1997-98 El Nino. Qingyun Zhang demonstrated strong year-to-year variability in both CRF and cloud fraction. Associated with this were changes in 850mb winds. Following some earlier studies, ratioing SW to LW CRF can be used as a diagnostic cloud vertical structure.

Session 2 Climate data preparation and analysis (*Chairs: Ge, Quansheng and David Easterling)*

David Easterling started the session by presenting a talk that examined evidence for observed climate change. He focused on temperature and showed the global time series for temperature, then some other results that reinforce the conclusion of observed warming in high latitudes including satellite observations of sea-ice loss. Very recent results of a new analysis of maximum and minimum temperature trends for the 1950-2003 period show that the previously found trends continue with the minimum temperature warming faster than the maximum and a resulting decrease in the diurnal temperature range. He then presented results examining changes in different parts of the statistical distribution for daily max/min temperature showing that the warming in the higher latitudes of North America is occurring in the coldest days of each month with less warming in the warmest days.

Hao Zhixin then discussed the development of a database of historical climate records using three kinds of source data: historical documents, instrumental data and natural evidence. The documentary information was from: ancient documents and historical records, gazettes, and archives. For example, each successive Chinese dynasty would compile a written history of the previous dynasty that would include information related to weather and climate. Records of droughts, floods, and pestilence were then used to develop the data base.

The next talk was by Dale Kaiser who reviewed some of the history of the U.S.-PRC agreement. He showed a number of slides and pictures of previous participants at some of the earlier science team meetings. Next he presented some of the previous research that the Carbon Dioxide Information and Analysis Center has performed during the

course of the project. In particular he showed results on decreases in sunshine and clouds, questioning why there would be decreases in both quantities when it is expected that with a decrease in one, there would be an increase in the other.

Ge Quansheng then discussed the development of seasonal precipitation reconstructions in the middle and lower reaches of the Yellow River for the last 300 years. The reconstruction was based on snow and rainfall records derived from the archives of the Qing Dynasty (1736-1911). Reconstructions were developed for the entire region and four sub-regions. Analysis of the reconstructions shows that there were 3 wet periods (around 1800, the 1820s and the late 1880s), and two drier periods (1916-1945 and the last two decades of the 20th century).

The final paper in the session was given by Qing-yun Zhang who discussed the seasonal variations of top of the atmosphere cloud radiative forcing and the interannaul variations of CRF over the East Asian monsoon region using the NCEP reanalysis and ERBE data. The largest anomaly for CRF was over the East Asian monsoon region.
The CRF of the EA monsoon region is sensitive to the large scale circulation especially the southwest wind over the EA monsoon region. The 850 hPa southwesterly wind advance and retreat over the monsoon region was most associated with the seasonal variations of the CRF.

Session 3 Global and regional budget studies and measurements of atmospheric trace constituents (*Chair: M.A.K. Khalil*)

There were three talks in the session focusing on greenhouse gases and aerosols. In the first talk, Aslam Khalil discussed the current work on emissions of methane and nitrous oxide from rice fields. He pointed out that the reduction in the land area used for rice agriculture and changes in agricultural practices, primarily replacement of organic with nitrogen fertilizers, and reduced water in the fields, have most likely led to significant decreases in the emissions of methane from rice fields in China of the order of 15 Tg/y over the last decade. This change, Dr. Khalil said, may be a significant contributor to the stabilization of the global atmospheric methane concentration that is currently being observed. Moreover, rice fields may now and in the future play a more important role in the global nitrous oxide increases and less so for methane trends, he said. Xinhua Zheng talked about experiments (FACE) that deal with the changes of greenhouse gas emissions from rice fields under increased carbon dioxide conditions. This would cause a feedback if carbon dioxide continues to build up in the atmosphere. She reported that the changes of methane and nitrous oxide were related to the combined effects of fertilizer use and increased carbon dioxide. The relationships are under investigation. The final talk presented by Renjian Zhang discussed results from several atmospheric composition measurements programs in China. He reported on the measurements of greenhouse gases and ozone depleting compounds at Minqin, a continental site in Gansu Province. He showed 2-d transport-chemistry model results to explain the concentrations of methane at this site. While the overall trend is in good agreement with model expectations, the model did not match the minimum seasonal concentrations very well. Zhang argued that some of the abnormal growth rates of methane observed in the data were possibly caused

by its coupling with carbon monoxide and atmospheric changes caused by the Mt. Pinatubo eruption. Zhang also reported aerosol chemical composition measurements in Beijing and its source apportionment, including the tracking of distant sources.

Session 4 Impacts and Assessment (*Chair: Aiguo Dai*)

Wang analyzed temperature and precipitation simulations from 10-regional climate models from China, Japan, S. Korea, and Australia. In general, the RCMs simulated the T and O fields over East Asia reasonably well. However, some biases were also identified. Future plans include using the RCMs to simulate future climate change over East Asia. Zheng examined changes in T, P, and spring advances of the growing season over East China during 1961-2000. It is found that the recent warming over much of East China is associated with spring advances (earlier start) of the growing season. Precipitation trend vary from region to region.

C. Agenda

October 29

8:30-9:00 Registration
9:00-9:30 Opening Ceremony (Chen, Panqin and Michael Riches)
9:30-10:00 Special Session
Michael Riches: U.S.-China Cooperation in Climate Science
10:00-10:30 _ *Break and Photo Session* _

Session 1: Modeling and Climate Prediction (*Chairs: Gerald Potter and Lu, Riyu*)
10:30-11:00 Gerald Potter: The CCPP-ARM Parameterization Test Bed (CAPT)
11:00-11:30 Yu, Yongqiang: A Coupled Climate Model Based on an Eddy-Permitting OGCM
11:30-12:00 Robert Cess: Testing the Impact of Clouds on the Radiation Budgets of 19 Atmospheric General Circulation Models
12:00-12:30 Wei-Chyung Wang: Study of Regional Climate Changes
13:00-14:00 _ *Lunch* _

14:00-14:30 Aiguo Dai: Recent Climate Change Modeling Work at NCAR
14:30-15:00 Jiang, Dabang: Last Glacial Maximum over China: Sensitivities of Climate to Paleovegetation and Tibetan Ice Sheet
15:00-15:15 _ *Break* _
15:15-15:45 Lin, Zhaohui: IAP Dynamical Climate Prediction System and Its Application to the Climate Anomalies Predictions over China
15:45-16:15 Lu, Riyu: Impact of Atlantic SST Anomalies on the Summer Rainfall in East Asia

Session 2 **Climate data preparation and analysis (*Chairs: Ge, Quansheng and David Easterling)***

16:15-16:45 **David Easterling**: A Review of Research and Data Set Development Work at the National Climatic Data Center: 1985 – 2003

16:45-17:15 **Hao, Zhixin**: Study on the Establishment and Application of Environmental Change Database during Historical Times

17:15-17:45 **Dale Kaiser**: Retrospective on Cooperative Research Efforts between the Chinese Academy of Sciences and DOE's Carbon Dioxide Information Analysis Center (CDIAC): 1984–2003

18:00 Banquet

October 30

Session 2 (continues)

9:00-9:30 **Ge, Quansheng**: Seasonal Precipitation Reconstruction in the Middle and Lower Reaches of the Yellow River for the Last 300 Years

9:30-10:00 **Zhang, Qingyun**: Cloud Radiative Forcing and the Associated Atmospheric Circulation over East Asia Monsoon Region

10:00-10:15 _ ***Break*** _

Session 3 **Global and regional budget studies and measurements of atmospheric trace constituents (*Chair: M.A.K. Khalil*)**

10:15-10:45 **Zheng, Xunhua**_Effect of Elevated Carbon Dioxide on Methane Emission from Paddy Rice Field

10:45-11:30 **M.A.K. Khalil and R. Rasmussen** (for two talks)**:** Greenhouse Gases from Rice Fields

11:30-12:00 **Zhang, Renjian:** A Study of Some Trace Atmospheric Components in North and Northwest China

12:00-14:00 _ ***Lunch*** _

Session 4 Impacts and Assessment (*Chair:* Aiguo Dai)

14:00-14:30 **Wang, Shuyu**: Regional Climate Model Inter-comparison Project for Asia

14:30-15:00 **Zheng, Jingyun**: Climate Changes and Its Impacts on Plant Phenology in China for the Last 40 Years

15:00-15:15 _ ***Break*** _

15:15-16:30 ***Break-Out Discussion*** **(*Chairs: Wei-Chyung Wang & Huijun Wang*)**

18:00 _ **Dinner** _

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